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# ARRANGEMENT AND PRESERVATION OF LARGE COLLECTIONS OF HUMAN BONES FOR PURPOSES OF INVESTIGATION.

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SINCE my mention, nearly a year ago,<sup>1</sup> of a definite method in the care of bones which are to be utilized for investigation, I have received several inquiries as to the details of such a method. As the subject is not without importance, I think it will be useful to bring the particulars to the general attention of the anatomists.

My practical experience with bones was gained principally in the anatomical department of the College of Physicians and Surgeons, New York, and in the American Museum of Natural History, the same city; besides this, I had a chance to make observations on a number of large anatomical, anthropological, and zoölogical bone collections both here and abroad.

The remarks which follow apply only to collections of human bones, in fact, principally to large (established or prospective) collections of the bones of whites. They apply further only to a general method of the care of bones, which will easily allow any especially desirable exceptions by individual investigators, such as the treatment of the whole spinal column (Dwight), pelvis, etc.

For small collections, for anthropological and zoölogical collections of bones, probably the best general rule is to keep, in appropriate series, all the bones of each skeleton together, minus the skull. Each bone should bear the number of the skeleton. The skulls of the same tribe of people or species of animals are kept together, heading the series. Each distinct group of skulls and skeletons in a collection is divided and arranged in at least three groups: the children or young,

<sup>1</sup> Before the Association of American Anatomists, New York, December, 1898, paper on Tibia.

and grown individuals, separated into males and females. In large series the embryos, adolescents, and very old may be advantageously separated from the others. The best way to preserve these collections is in tiers of sliding shelves or drawers. The anthropological collection as a whole is arranged on the basis of race and type, and further subdivided according to the geographical distribution. A zoölogical collection is naturally best arranged on the basis of the grade of evolution of the animals. This rule may be followed from the most comprehensive zoölogical subdivision to individuals.

The method of arrangement in large collections of human bones of a comparatively homogeneous character, such as the bones of whites, when the object of these collections is to be a possibility of a thorough investigation on the bones, must differ from the above.

Anatomy is past the stage of study of single normal bones, just as it is past the stage of study of any single normal organ in the body. The present and future anatomical investigations can only deal with large numbers of specimens. The points which are to be settled by the investigations concern, in the first place, the regular changes or life history of each individual bone. We are further to learn the prevalent types of each bone and their meaning; to complete our knowledge of the more primitive, recurrent, and anomalous, and define the prospective characters of each bone; and to establish the influences on the various bones of recent as well as hereditary, normal, and abnormal characters.

In order that such studies may be possible, all the bones in our collections must, in the first place, be *identified*; in the second place, they must be *supplemented with certain data on the subjects from which they proceed*; and in the third place, the bones must be so *stored as to present the utmost facility for any study desired*.

So far no osteological collection of which I have any knowledge comes fully up to the stated requirements; the collection that comes nearest to the desired standard is in all probability that of Prof. Geo. S. Huntington, in the College of Physicians and Surgeons, New York City. However, as the value and

promises of advanced investigation on bones will receive, which they cannot fail to do, a more thorough appreciation by the teachers and students in anatomy, old bone collections will increase and new collections will be established, and both these effects should take place only on the basis of the most approved principles.

Such were the considerations which led me in formulating, during the last four years, the system of care of bones, which follows. Every point advocated I had the occasion to test or observe in practice, and only that is included which is simple, practical, and essential for investigation. Some of the details which at first may seem superfluous will be appreciated later by the student of the collection. The method once tested under different circumstances in practice will undoubtedly be found capable of advantageous modifications, but I think it will, in general, prove sufficient for the beginning of a collection. . . .

The *care of bones*, when their full scientific utilization is in view, should begin at the reception of the body in the anatomical department.

It is very advisable, on receiving the body, to ascertain the following points, namely: color, sex, age, nationality (if American, the nationality of parents in addition), and last disease; also the principal (not necessarily the last) occupation of the individual in his life.

In all accidental or sudden deaths the weight of the body, with a note as to loss of blood, should be taken.

A few selected, simple measures of the body<sup>1</sup> and head are very desirable.

All the data, if *carefully* obtained, will serve as valuable bases for future studies and comparisons on the skeleton.

It is best that one of the permanent associates in the anatomical department of a college should be given the care of all these preliminaries.

<sup>1</sup> Length of the body: middle of the soles to vertex; maximum length and width of the head, with its height from biauricular line; antero-posterior and lateral diameters of the chest, at the level of the sternal articulation of the third ribs and at that of ensiform cartilage. Vertex-coccyx length is also a desirable measure.

All records should be preserved in a special book. Each case receives its number; it is best to carry the numbers on consecutively, for that will, among other advantages, facilitate references.

The number a body has been given and the year when received, are stamped indelibly on a card, and this is so attached to the body as not to be lost. When the body comes on the dissecting table, various means may be used to keep the subject identified. In all cases it is well to preserve the original card secured in some way at the table.

While the body is being dissected, care must be exercised that the different parts are not displaced. As soon as any long bone, or the scapula, or innominatum, sacrum, lower jaw or skull, is finished with, it should be the duty of some one in the dissecting room to attach by wire a little metal tag to it, with stamped-in number of the subject (zinc, or zinc-lead alloy wire and metal are to be used; steel wire will not last, while copper wire will color the bone).

All the short bones of each group (hand, foot, sternum and ribs, vertebral column) are placed into a small-mesh zinc wire cage, or into a small net (which latter, however, should be strong enough to resist boiling or maceration), and to each cage or net a similar metal tag is appended as to each larger bone.<sup>1</sup>

The tags are to stay on all the bones to which they were attached individually. On the short bones, when prepared and dried (which latter should be done with the bones still in their sacks or cages), the number of the subject is placed in indelible ink.

Chemicals should be avoided in the preparation of bones for study, as they affect the bone weight and specific gravity, both valuable points for investigation. Too long boiling is also injurious, particularly to the bones of the young or old.

The problem of *storing* prepared and marked bones is of considerable importance. It presents several distinct points to which attention must be directed, namely: (1) the bones should be stored so as to be protected against dust, sunlight, and

<sup>1</sup> System successfully used at the College of Physicians and Surgeons, New York.

great changes of temperature or moisture, and occasionally also against insects or rodents ; and (2) the bones should be stored in such a way as to be readily and easily accessible and offer the utmost facilities for study or exhibition, as well as an ease of proper replacement. These desiderata can be accomplished as follows :

1. A fairly well lighted, dry room is lined with shelf frames, or drawer frames. Other similar frames can be placed across parts of the room when necessary. The frames are so arranged that the drawers or boxes which are to be placed in them can slide in and out (this can be arranged quite simply and inexpensively). The size of the frames is determined by the size of the boxes or drawers, which must be of two or three dimensions. A very good preventive against insects, or even rodents, is a little of paris green mixed with some sugar and flour.

2. For the small bones it is best to provide light boxes just a little larger than necessary to contain their groups (speaking of adults). Low partitions (potter's clay) in these boxes would enable us to subdivide each group of small bones and much facilitate their study. A definite number of coverless boxes fit into a drawer, on which are plainly and indelibly marked the character and number ( $x-x$ ) of the contents. It is best to have the drawers just large enough to accommodate the boxes with all the small bones of each individual skeleton, and to keep these bones permanently together.

The long bones may be stored in two ways, each of which has certain advantages.

All the long and other bones of the skeleton, remaining after the disposal of short bones as outlined above, minus the skull and lower jaw, can be placed together in a special drawer, which can then be placed, properly marked, next the drawer with the short bones of the same skeleton. Thus, all the bones of each skeleton, minus the skull, which can easily be found, are kept close together.

When very large series of bones are to be studied, the following method of storage is preferable : More spacious drawers are provided ; or there may be simply shelves with closed

compartments, each of which has a door that ought to open downward. The bones are stored into these compartments according to the kind and side, and in series of consecutive numbers. Each large bone in the body has its own section of the shelves. The size of each section may be calculated on the basis of the space necessary to accommodate five hundred, one thousand, or a larger series of specimens. The kind and numbers ( $x-x$ ) of bones are marked in this case (because changes will take place in the number or quality of the exact contents, *v. below*) preferably on cards, which are nailed or otherwise attached to the drawers.

The skulls, including lower jaws, it is best to store separately, in drawers accommodating a certain number each, and carrying in a prominent place a record of their contents.

So far for simple *preliminary* storing. The next step in arranging a large bone collection is the separation of each series of bones into three subseries, containing the normal, pathological, and anomalous bones.

The normal bones should be further subdivided according to sex (which is also applicable to the other subseries, if large). A still further advantageous subdivision of the series of bones, but only in the largest collections, is that based on racial (nationality) character of the bones.

The bones of children, and those of negroes (unless plentiful) and rare subjects, are best kept separately, a large box being provided for each skeleton.

When an anomalous or pathological bone or bones are removed from a series, a card should be kept with the series of the location of the specimens.

To complete the value of a bone collection, a card catalogue is a necessity. This may be conducted with various degrees of thoroughness. The simplest catalogue is that where each skeleton receives one card, on which are stated the history of the body (copy of the record made before dissection) and the main pathological or anomalous conditions observed on the skeleton. The ideal and most complete catalogue would be that where *each bone* would receive a card, which would bear its special characters and its dimensions.

The arrangement of specimens for *exhibition* differs much from that for storage. It should be based on at least two principles, namely: The normal bones should be arranged in series showing all their variations, the pathological and anomalous bones in series showing as many grades or steps as possible in the evolution of their specific characters. The series are arranged according to the order in which the bones of the human body are generally treated in anatomical works or lectures. Wherever possible, the series should be supplemented by casts or pictures and by specimens from lower mammals, fit for comparison. Explanatory labels with references, and, if possible, with a special card catalogue for the museum, complete the value of the exhibitions.

NEW YORK, 106 East Seventy-first St.